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(54) ELECTROPHORETIC DISPLAY WITH ARC DRIVEN INDIVIDUAL PIXELS

ELEKTROPHORETISCHE ANZEIGE MIT ARC-GESTEUERTEN PIXELS

AFFICHAGE ELECTROPHORETIQUE A PIXELS COMMANDES PAR ARC

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- **PATENT ABSTRACTS OF JAPAN vol. 2 no. 121 (E-063) & JP-A-53 088599 (MATSUSHITA)**

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Description

Technical Field of the Invention

[0001] The present invention relates to an electrophoretic display panel apparatus and, more particularly, to an electrophoretic display having independent pixel elements driven by an arc through an ionizable gas.

Background Art

[0002] Electrophoretic displays (EPIDS) are now well known. A variety of display types and features are taught in several patents issued in the names of the inventors herein, Frank J. DiSanto and Denis A. Krusos and assigned to the assignee herein, Copytele, Inc. of Huntington Station, New York. For example, U.S. Patent Nos. 4,655,897and 4,732,830,each entitled **ELECTROPHORETIC DISPLAY PANELS AND ASSOCIATED METHODS** describe the basic operation and construction of an electrophoretic display. U.S. Patent No. 4,742,345, entitled **ELECTROPHORETIC DISPLAY PANELS AND METHODS THEREFOR**, describes a display having improved alignment and contrast. Many other patents regarding such displays are also assigned to Copytele, Inc.

[0003] The display panels shown in the above-mentioned patents operate upon the same basic principle, viz., if a suspension of electrically charged pigment particles in a dielectric fluid is subjected to an applied electrostatic field, the pigment particles will migrate through the fluid in response to the electrostatic field. Given a substantially homogeneous suspension of particles having a pigment color different from that of the dielectric fluid, if the applied electrostatic field is localized it will cause a visually observable localized pigment particle migration. The localized pigment particle migration results either in a localized area of concentration or rarefaction of particles depending upon the polarity and direction of the electrostatic field and the charge on the pigment particles. The electrophoretic display apparatus taught in the foregoing U.S. Patents are "triode-type" displays having a plurality of independent, parallel, cathode row conductor elements or "lines" deposited in the horizontal on one surface of a glass viewing screen. A layer of insulating photoresist material deposited over the cathode elements and photoetched down to the cathode elements to yield a plurality of insulator strips positioned at right angles to the cathode elements, forms the substrate for a plurality of independent, parallel column or grid conductor elements or "lines" running in the vertical direction. A glass cap member forms a fluid-tight seal with the viewing window along the cap's peripheral edge for containing the fluid suspension and also acts as a substrate for an anode plate deposited on the interior flat surface of the cap. When the cap is in place, the anode surface is in spaced parallel relation to both the cathode elements and the grid elements. Given a specific particulate suspension, the sign of the electrostatic charge which will attract and repel the pigment particles will be known. The cathode element voltage, the anode voltage, and the grid element voltage can then be ascertained such that when a particular voltage is applied to the cathode and another voltage is applied to the grid, the area proximate their intersection will assume a net charge sufficient to attract or repel pigment particles in suspension in the dielectric fluid. Since numerous cathode and grid lines are employed, there are numerous discrete intersection points which can be controlled by varying the voltage on the cathode and grid elements to cause localized visible regions of pigment concentration and rarefaction. Essentially then, the operating voltages on both cathode and grid must be able to assume at least two states corresponding to a logical one and a logical zero. Logical one for the cathode may either correspond to attraction or repulsion of pigment. Typically, the cathode and grid voltages are selected such that only when both are a logical one at a particular intersection point, will a sufficient electrostatic field be present at the intersection relative to the anode to cause the writing of a visual bit of information on the display through migration of pigment particles. The bit may be erased, e.g.,upon a reversal of polarity and a logical zero-zero state occurring at the intersection coordinated with an erase voltage gradient between anode and cathode. In this manner, digitized data can be displayed on the electrophoretic display.

[0004] Besides the triode-type display, the applicant's herein have proposed a variety of EPID structures for utilizing the electrophoretic effect. For example, an alternative EPID construction is described in Application No. 07/345,825, now U.S. Patent No. 5,053,763, entitled **DUAL ANODE FLAT PANEL ELECTROPHORETIC DISPLAY APPARATUS**, which relates to an electrophoretic display in which the cathode/grid matrix as found in triode-type displays is overlayed by a plurality of independent, separately addressable "local"anode lines. The local anode lines are deposited upon and aligned with the grid lines and are insulated therefrom by interstitial lines of photoresist. The local anode lines are in addition to the "remote" anode, which is the layer deposited upon the anode faceplate or cap as in triode displays. The dual anode structure aforesaid provides enhanced operation by eliminating unwanted variations in display brightness between frames, increasing the speed of the display and decreasing the anode voltage required during Write and Hold cycles, all as explained therein.

[0005] In general, it can be noted that a variety of EPID configurations have been proposed by the prior an. In the quest for better EPID's, improvements in resolution, speed of operation, simplicity of construction, reliability and economy continue to be sought.

[0006] An object of the present invention is to achieve an improved EPID structure and function.

Disclosure of the Invention

[0007] The problems and disadvantages associated with conventional electrophoretic displays are overcome by the present invention as defined by each one of claim 1 and claim 14. A device in accordance with the invention includes a first receptacle containing electrophoretic fluid and a second receptacle containing an ionizable gas. The first and second receptacles share a common barrier wall and a plurality of conductive pathways penetrate the barrier wall. A first end of the conductive pathways is disposed proximate the fluid while a second end is in contact with the gas. Apparatus is provided for ionizing the gas proximate selected conductive pathways to bias those selected pathways in order to induce movement of pigment in the fluid' proximate the first end of the selected conductive pathways.

Brief Description of the Drawings

[0008] For a better understanding of the present invention, reference is made to the following detailed description of an exemplary embodiment considered in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view of an electrophoretic display in accordance with an exemplary embodiment of the present invention.

FIG. 2 is an enlarged cross-sectional view of the EPID shown in FIG. 1 taken along section line II-II and looking in the direction of the arrows.

FIG. 3 is a rear elevational view of the intermediate pixel carrier plate of the EPID shown in FIGs. 1 and 2.

FIG. 4 is a front elevational view of the column conductor carrier plate of the EPID shown in FIGs. 1 and 2.

FIG. 5 is an enlarged diagrammatic view of a fragment of the EPID shown in FIG. 2 illustrating operation.

Best Mode for Carrying Out the Invention

[0009] FIG. 1 shows an electrophoretic display or EPID 10 having a front faceplate 12, an intermediate pixel carrier plate 14 and a backplate 16. Typically, the plates 12, 14 and 16 would be formed from glass due to its transparency, dielectric strength and compatibility with photoetching processes. The plates are separated by spacers 18 which join the respective plates about their periphery forming a pair separate internal envelopes or receptacles, a first for containing electrophoretic fluid and a second for containing an ionizable gas, as shall be seen and described more fully below. The spacers are typically mylar and are bonded to the respective plates making up the EPID 10 by epoxy which flows under the influence of pressure and heat and upon cooling bonds to form an airtight and fluid tight seal. The faceplate of the EPID 10 has a substantially clear indium-tin-oxide (ITO) electrode 20 deposited on the interior surface thereof through which the electrophoretic effect may be visualized. A plurality of individual pixels 22 disposed on the intermediate pixel carrier plate 14 are depicted in dashed lines. Like the faceplate electrode 20, the individual pixels 22 may be formed of indium- tin-oxide (ITO) and are electrically conductive. In the alternative, metals such as chrome could be employed. Methods for depositing and shaping indium-tin-oxide on glass substrates are known in the art and are described, e.g.,in the above-referenced U.S. Patent Nos. 4,655,897and 4,732,830.

[0010] FIG. 2 illustrates the interior components of the EPID 10. An anterior sealed chamber 24 receives electrophoretic fluid which includes a dielectric fluid and suspended therein a dispersion of colloidal surface-charged pigment particles, as is known in the art. Examples of typical electrophoretic fluids are referred to in U.S. Patents Nos. 4,655,897and 4,732,830. One such typical fluid employs a dark blue or black dielectric along with yellow negatively surface-charged pigment particles. A posterior chamber 26 formed by the sealing of mylar seals 18 to plates 14 and 16 contains an ionizable gas such as Argon, Xenon or Neon or a mixture of such gases. The rear plate 16 supports a plurality of parallel column conductor lines 28 disposed in this view in the "vertical direction". The conductor lines 28 may be formed from ITO, chrome or any other conductor material in a manner which is conventional in the art, such as photoetching, plasma etching, etc. The individual pixel elements 22 disposed upon the intermediate pixel carrier plate 14 are electrically connected to associated conductor pins 30 formed from copper or any other suitable conductor. The conductor pins 30 penetrate the intermediate pixel carrier plate 14 such that a portion protrudes toward the backplate 16 within the posterior chamber 26 and a portion protrudes toward the interior chamber to establish contact with an associated individual pixel 22. If the vertical conductor members or column lines 28 are arbitrarily described as "vertical", the individual pixels may be said to be horizontally grouped in rows which are disposed at right angles to the vertical conductor lines 28. The grouping of the individual pixels 22 and associated conductor pins 30 is established by row conductor lines 32 which traverse the intermediate pixel carrier plate 14 proximate to but not in conductive association with the conductor pins 30. Preferably, a row conductor line 32 is disposed on either side of a set or row of conductor pins 30 as shall be seen more conveniently in FIG. 3. A pair of driver circuits 33, 35 for driving the respective electrodes 20, 28 and 32 are shown diagrammatically and are such as are known in the art as, e.g., represented by the teachings of U.S. Patent Nos. 4,655,897 and 4,732,830.

[0011] FIG. 3 shows the rear portion of the intermediate pixel carrier plate 14 with the conductor pins 30 penetrating the plate and projecting towards the viewer.

The conductor pins 30 are organized into rows by pairs of row conductor lines 32 which traverse the intermediate pixel carrier plate 14 proximate to but not touching the conductor pins 30. In order to provide a uniform electrostatic field proximate the individual conductor pins 30, each of a pair of the row conductor lines assumes a semicircular shape proximate thereto which semicircles are conjoined to encircle the pins 30 and coaxial spacing 33.

[0012] FIG. 4 shows the front portion of backplate 16 upon which is disposed a plurality of vertical conductor lines 28. As can be seen by referring to FIGs. 2, 3 and 4, the vertical conductor lines 28 align with individual pixel members 22 and corresponding conductor pins 30 thereby forming a matrix with the horizontal row conductor lines 32. The conductor pins 30 are disposed at each intersection of the matrix. In this respect, an X,Y addressable matrix is formed with the individual pixels 22 disposed at the addressable points on the matrix.

[0013] FIG. 5 shows an enlarged fragment of the display 10 shown in FIG. 2 with one of the conductor pins 30 supporting an electric arc 34 traversing the gap between itself and an associated vertical conductor line 28. The electric arc is supported by the local ionization of the gas filling the posterior chamber 26 and originates from row conductor line 32. Given a voltage drop between a particular row conductor line 32 and an intersecting vertical conductor line 28 which is equal to or greater than the threshold voltage to create ionization across a particular physical gap, an electric discharge will occur as illustrated by electric arc 34. The threshold voltage is dependent upon the gas and the size of the gap. Since the conductor pin 30 is interposed into the arc pathway from the row conductor lines 32 to the vertical conductor column lines 28, the conductor pin 30 is raised to a voltage level corresponding to that of the electric arc 34 at the point where the arc enters the conductor pin 30. Given that the conductor pin 30 is in electrical continuity with a single pixel 22, the potential of pixel 22 is also raised or lowered to the voltage of the conductor pin. In this manner, the pigment particles can be controlled, that is by setting the voltage of the individual pixels 22 in accordance with the voltage level of the electric arc 26. In FIG. 5, the electric arc is induced by a positive voltage gradient from the row conductor line 32 to the vertical conductor line 28 such that the conductor pin 30 is raised to a high positive voltage thereby attracting the pigment particles 36 towards the individual pixel 22. This can be described as writing the pixel. The remainder of the pigment particles 36 are retained on the faceplate electrode 20 by a zero or slightly positive voltage in areas adjacent to pixels 22 not influenced by the electric arc. It should be recalled that the anterior chamber 24 contains electrophoretic fluid which is a dielectric fluid suspending pigment particles 36 therein. In accordance with the operation of electrophoretic displays, the concentration of pigment particles proximate to or distal to the faceplate 12 is responsible for the display characteristics, namely if yellow pigment particles 36 are adhered to the faceplate electrode 20, the resultant image will appear yellow in all areas with pigment particles 36 so adhered. In areas where the pigment particles are removed, that is, towards the pixels 22, the background dielectric solution color, for example black, will be evidenced. Thus, a convention is usually established in describing the electrophoretic display operation wherein a written pixel is either the absence of pigment particles, that is, a black pixel upon a yellow background defined by the presence of pigment particles, or vice-versa. In the present example, we will use the convention that a written pixel will be black and that the pigment particles 36 are yellow and negatively charged. What has been described then is an apparatus for creating an electric arc at a selected intersection of row conductor lines 32 and vertical conductor lines 28 to thereby influence pigment particles in an electrophoretic fluid which are further controlled by a planar faceplate electrode 20. By way of further example and explanation, assume that V_1 volts is necessary to cause the gas between a conductor pin 30 and a vertical conductor line 28 to ionize and that V_2 is equal to ½ V_1. If all the row conductor lines 32 are set at V_1 volts, and all the vertical conductor members are set at V_2, the gas will not ionize at any intersection. If the horizontal row conductor lines 32 are sequentially placed at V_1 volts and the vertical conductor lines 28 are either left at V_2 or placed at 0 volts in accordance with a data pattern, then the gas between the electrodes which have a potential difference of V_1 volts will ionize. The conductor pins 30 which are in contact with the ionized gas will therefore be at a potential approximating V_1 and the charged pigment particles 36 will move in a direction consistent with the polarity of V_1 since the ITO of the faceplate electrode 20 is maintained close to zero potential. For example, if the row conductor lines 32 are sequentially placed at + 100 volts and the vertical conductor lines 28 are maintained at + 50 volts with a 100 volt differential required for ionization to occur, all vertical conductor lines which are placed at zero volts will then cause an ionization at that location. It should be appreciated that a negative voltage of, e.g., -100 volts imposed on row lines 32 would reach the ionization threshold at intersections with column lines 28 at 0 volts. This would result in the associated pixel at that intersection acquiring a potential approximating -100 volts thus repelling pigment particles to the faceplate electrodes 20 and thereby "erasing" the pixel. After each row of individual pixels 22 is written or erased, the gas is deionized setting up a capacitive affect between the individual pixels 22 and the faceplate electrode 20 since the pixels remain at the arc threshold voltage V_1 until discharged through the resistance of the electrophoretic fluid. The pixels 22, as capacitors, charge quickly through the low resistance of the ionized gas and discharge slowly through the high resistance of the electrophoretic fluid. If, for example, the pixels 22 are 0.114 mm (0.0045)

inches by 0.114 mm (0.0045) inches and the space between the faceplate electrode 20 and the pixel 22 is approximately 0.114 mm (0.0045) inches then the effective capacitance at each pixel is on the order of 8 microfarrads. Thus, a current in the micro-amp range can easily charge the capacitor in 50 microseconds even to a voltage of 100 volts. The same capacitive pixel 22 will require many milliseconds to discharge because of the high resistance of the suspension. In this manner, a unique TFT arrangement can be achieved and the panel can be written at very fast rates approaching those of video. In accordance with an alternative embodiment, holes of approximately 0.09144 mm (0.0036 inches) in diameter in the intermediate pixel carrier plate 14 could be employed instead of the conductor pins 30 which traverse the plate from the pixel to the gas envelope in the posterior chamber 26. The holes would form a matrix of individual gas discharge lamps. This configuration can readily be envisioned by simply removing the probes 30 shown in FIG. 5.

[0014] It should be understood that the embodiments described herein are merely exemplary and that a person stilled in the art may make many variations and modifications without departing from the scope of the invention as defined in the appended claims.

Claims

1. An electrophoretic display (10), comprising:

   a dielectric barrier wall (14) having a first surface and an opposite second surface;
   a transparent faceplate (12) disposed proximate said first surface of said barrier wall wherein said transparent faceplate and said first surface of said barrier wall define at least part of a fluid impermeable receptacle (24);
   a backplate (16) disposed proximate said second surface of said barrier wall, wherein said backplate and said second surface of said barrier wall define at least part of a gas impermeable receptacle (26);
   an electrophoretic dispersion containing electrophoretic particles (36) suspended in a suspension fluid, wherein said dispersion is contained within said fluid impermeable receptacle;
   an ionizable gas contained within said gas impermeable receptacle;
   a plurality of conductive elements (30) extending through said barrier wall from said first surface to said second surface, wherein each of said conductive elements are insulated from each other and each of said conductive elements communicates with said electrophoretic dispersion and said ionizable gas;
   a first plurality of conductive pathways (32) disposed on said second surface of said barrier wall;
   a second plurality of conductive pathways (28) disposed on said backplate; and
   means for producing an arc (34) through said ionizable gas between one of said first plurality of conductive pathways and one of said second plurality of conductive pathways, wherein said arc applies an electrical bias to one of said conductive elements that traverses the barrier wall and creates an electrophoretic effect within said electrophoretic dispersion.

2. The device of Claim 1, wherein said first plurality of conductive pathways includes a plurality of substantially parallel column conductor lines disposed or a second surface of said barrier wall and said second plurality of conductive pathways include a plurality of row conductor lines disposed on said backplate in an orientation that is substantially perpendicular to said column conductor lines, thereby forming an addressable X-Y matrix.

3. The device of Claim 2, further including a reference electrode (20) disposed on said faceplate, wherein said reference electrode is in contact with said electrophoretic dispersion and generally faces said first surface of said barrier wall.

4. The device of Claim 3, further including means for applying a predetermined electrical bias to said reference electrode.

5. The device of Claim 1 further including a plurality of discrete conductive pixels (22) disposed upon said first surface of said barrier wall, wherein each of plurality of pixels is paired in electrically conductive association with a corresponding one of said plurality of conductive elements.

6. The device of Claim 2, wherein each of said plurality of conductive elements is disposed on said second surface of said barrier wall at a position proximate a corresponding intersection of said X-Y matrix.

7. The device of Claim 1, wherein said faceplate is bonded to said barrier wall with a first insulating spacer (18) that separates said faceplate from said barrier wall and defines said fluid impermeable receptacle.

8. The device of Claim 7, wherein said backplate is bonded to said barrier wall with a second spacer (18) that separates said backplate from said wall and defines said gas impermeable receptacle.

9. The device of Claim 8 wherein said reference electrode is disposed upon said faceplate, a plurality of

column lines are disposed on said backplate and a plurality of row lines are disposed upon said barrier wall.

10. The device of Claim 1, wherein said faceplate, said backplate and said barrier wall are each substantially parallel, coextensive, plate-like members.

11. The device of Claim 1, wherein said backplate and said barrier wall are each substantially transparent.

12. The device of Claim 2, wherein said plurality of row conductor lines are grouped in pairs maintained at equivalent electrical potential relative each other and said conductive elements arranged in a plurality of rows, each between a corresponding pair of row conductor lines.

13. The device of Claim 5, wherein said pixels, said first plurality of conductive pathways and said second plurality of conductive pathways are formed from indium tin oxide and are substantially transparent.

14. A method for operating an electrophoretic display having a first receptacle (24) containing an electrophoretic dispersion, a second receptacle (26) containing an ionizable gas, said first and second receptacles sharing a common barrier wall (14), a plurality of conductive elements (30) extending through said barrier wall with a first end thereof in contact with said fluid and a second end in contact with said gas comprising the steps of:

selectively producing an arc (34) in said second receptacle proximate said second end of at least one selected element from said plurality of conductive elements, said arc ionizing said gas proximate said second end producing an electrical bias in said at least one selected element, wherein said electrical bias is experienced by said first end of said at least one selected element and induces an electrophoretic effect in said fluid proximate said first end of said at least one selected element.

15. The method of Claim 14, wherein said display includes a plurality of parallel column conductor lines (32) disposed on a first surface of said display within said second receptacle and a plurality of row conductor lines (28) insulated therefrom and disposed upon a second surface of sad display within said second receptacle to form an addressable X-Y matrix, said step of selectively producing an arc including the step of establishing a voltage differential at selected intersections of said matrix proximate to said second end of said at least one selected element.

16. The method of Claim 15, wherein said display includes a reference electrode (20) contained within said first receptacle insulated from said first end of said plurality of conductive elements and wherein said electrophoretic effect is determined by a local voltage differential between said reference electrodes and said bias of said first end of said at least one selected element.

17. The method of Claim 16, wherein the polarity of said local voltage differential determines the direction of pigment motion relative to said reference electrode.

18. The method of Claim 17, further including the step of retaining pigment particles (36) in a position occupied subsequent to inducing the electrophoretic effect by removing said voltage differential at said selected intersections thereby deionizing said gas at said selected intersections and setting up a capacitance between said first end of said selected conductive elements and said reference electrode.

Patentansprüche

1. Elektrophoretische Displayvorrichtung (10), welche umfaßt:

eine dielektrische Trennwandung (14) mit einer ersten und einer gegenüberliegenden zweiten Oberfläche;

eine durchsichtige Front-oder Vorderplatte bzw. -wand (12), die nächst der ersten Oberfläche der Trennwandung angeordnet ist, derart daß die durchsichtige Frontplatte und die erste Oberfläche der Trennwandung wenigstens einen Teil einer strämungsmitteldichten Behälterkammer (24) definieren;

eine nächst der zweiten Oberfläche der Trennwandung angeordnete Hinter-oder Rückplatte bzw. -wandung (16), wobei diese Hinterwandung und die zweite Oberfläche der Trennwandung eine gasdichte Behälterkammer (26) bilden;

eine elektrophoretische Dispersion, welche elektrophoretische Teilchen (36) in einem Suspensions-Strämungsmittel suspendiert enthält, wobei diese Dispersion in der genannten strömungsmitteldichten Behälterkammer enthalten ist;

ein in der genannten gasdichten Behälterkammer enthaltenes ionisierbares Gas;

eine Mehrzahl von sich durch die Trennwandung von deren erster zu deren zweiter Oberfläche erstreckenden Leiterelementen (30), wobei die einzelnen Leiterelemente jeweils gegeneinander isoliert sind und jedes Leiterelement jeweils mit der elektrophoretischen Dispersion und mit dem ionisierbaren Gas in Verbindung steht;

eine erste Mehrzahl von auf der zweiten Oberfläche der Trennwandung angeordneten Leiterpfaden (32);

eine zweite Mehrzahl von auf der Rückwandung bzw.-platte angeordneten Leiterpfaden (28);

Mittel zur Erzeugung eines Lichtbogens (34) durch das ionisierbare Gas hindurch zwischen einem Leiterpfad der ersten Mehrzahl von Leiterpfaden und einem Leiterpfad der zweiten Mehrzahl von Leiterpfaden, wobei der Lichtbogen einem der Leiterelemente eine elektrische Vorspannung erteilt, welche die Trennwandung durchsetzt und einen elektrophoretischen Effekt in der elektrophoretischen Dispersion hervorruft.

2. Displayvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die erste Mehrzahl von Leiterpfaden eine Mehrzahl von im wesentlichen parallelen linearen Spalten-Leitern umfaßt, die auf einer zweiten Oberfläche der Trennwandung angeordnet sind, und daß die zweite Mehrzahl von Leiterpfaden eine Mehrzahl von linearen Zeilen-Leitern umfaßt, die auf der Rück- bzw. Hinterplatte in einer zu den linearen Spalten-Leitern im wesentlichen rechtwinkligen Ausrichtung angeordnet sind, unter Bildung einer adressierbaren X-Y Matrix.

3. Displayvorrichtung nach Anspruch 2, welche des weiteren eine auf der Front-bzw. Vorderplatte angeordnete Bezugselektrode (20) umfaßt, wobei diese Bezugselektrode mit der elektrophoretischen Dispersion in Kontakt steht und allgemein der ersten Oberfläche der Trennwandung zugewandt ist.

4. Displayvorrichtung nach Anspruch 3, welche des weiteren Mittel zum Anlegen einer vorgegebenen Vorspannung an die Bezugselektrode umfaßt.

5. Displayvorrichtung nach Anspruch 1, welche des weiteren eine Mehrzahl von auf der ersten Oberfläche der Trennwandung angeordneten diskreten, leitenden Pixeln (22) umfaßt, wobei jeweils jedes Pixel der Pixel-Vielzahl paarweise in elektrisch leitender Zuordnung zu einem Leiterelement der Vielzahl von Leiterelementen steht.

6. Displayvorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß jeweils jedes Leiterelement der Vielzahl von Leiterelementen auf der zweiten Oberfläche der Trennwandung an einer Stelle nächst einem entsprechenden Schnittpunkt der X-Y -Matrix angeordnet ist.

7. Displayvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Front- bzw. Vorderplatte mit der Trennwandung über einen ersten isolierenden Abstandshalter (18) verbunden ist, welcher die Front- bzw. Vorderplatte von der Trennwandung getrennt hält und die genannte strämungsmitteldichte Behälterkammer definiert.

8. Displayvorrichtung nach Anspruch 7, dadurch gekennzeichnet, daß die Rück- bzw. Hinterplatte mit der Trennwandung über einen zweiten Abstandshalter (18) verbunden ist, welcher die Rück- bzw. Hinterplatte von der Trennwandung getrennt hält und die genannte gasdichte Behälterkammer definiert.

9. Displayvorrichtung nach Anspruch 8, dadurch gekennzeichnet, daß die Bezugselektrode auf der Front- bzw. Vorderplatte angeordnet ist, daß eine Vielzahl von Spaltenlinien auf der Rück- bzw. Hinterplatte angeordnet sind, und daß eine Vielzahl von Zeilenlinien auf der Trennwandung angeordnet sind.

10. Displayvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Front- bzw. Vorderplatte, die Rück- bzw. Hinterplatte und die Trennwandung jeweils zueinander im Wesentlichen parallele plattenförmige Teile gleicher Erstreckung sind.

11. Displayvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Rück- bzw. Hinterplatte und die Trennwandung jeweils im wesentlichen durchsichtig sind.

12. Displayvorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß die Mehrzahl von linearen Zeilen-Leitern in jeweils auf relativ zueinander äquivalentem Potential gehaltenen Paaren gruppiert sind und daß die Leiterelemente in einer Vielzahl von Zeilen angeordnet sind, deren jede jeweils zwischen einem entsprechenden Paar von linearen Zeilenleitern liegt.

13. Displayvorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß die erste Mehrzahl von Leiterpfaden und die zweite Mehrzahl von Leiterpfaden aus Indium-Zinn-Oxyd hergestellt sind und im wesentlichen durchsichtig sind.

14. Verfahren zum Betrieb einer elektophoretischen Displayvorrichtung, welche eine eine elektrophoretische Dispersion enthaltende erste Behälterkammer (24), eine ein ionisierbares Gas enthaltende zweite Behälterkammer (26), wobei die erste und die zweite Behälterkammer eine gemeinsame Trennwandung (14) miteinander teilen, sowie eine Mehrzahl von sich durch diese Trennwandung erstreckenden Leiterelementen (30) aufweist, welche an einem ersten Ende mit dem genannten Strömungsmittel und an einem zweiten Ende mit dem genannten Gas in Kontakt stehen, wobei das Verfahren die Schritte umfaßt:

    selektive Erzeugung eines Lichtbogens (34) in der zweiten Behälterkammer nächst dem zweiten Ende wenigstens eines ausgewählten Elements der Vielzahl von Leiterelementen, wobei der Lichtbogen das Gas nächst dem zweiten Ende ionisiert und eine elektrische Vorspannung in dem genannten wenigstens einen ausgewählten Element erzeugt, und wobei diese elektrische Vorspannung an dem ersten Ende des genannten wenigstens einen ausgewählten Elements wirksam auftritt und in dem Strömungsmittel nächst dem ersten Ende des erwähnten wenigstens einen ausgewählten Elements einen elektrophoretischen Effekt induziert.

15. Verfahren nach Anspruch 14, wobei die Displayvorrichtung eine auf einer ersten Oberfläche des Displays innerhalb der zweiten Behälterkammer angeordnete Vielzahl linearer paralleler Spalten-Leiter (32) sowie eine von diesen isolierte und auf einer zweiten Oberfläche des Displays innerhalb der zweiten Behälterkammer angeordnete Vielzahl linearer Zeilen-Leiter (28) zur Bildung einer adressierbaren X-Y Matrix aufweist, wobei der genannte Verfahrensschritt der selektiven Erzeugung eines Lichtbogens den Verfahrensschritt der Erzeugung eines Spannungs-Differentials an ausgewählten Schnittpunkten dieser Matrix nächst dem zweiten Ende des erwähnten wenigstens einen ausgewählten Elements umfaßt.

16. Verfahren nach Anspruch 15, wobei die Displayvorrichtung eine Bezugselektrode (20) aufweist, die innerhalb der ersten Behälterkammer von dem ersten Ende der erwähnten Vielzahl von Leiterelementen isoliert enthalten ist, und wobei der erwähnte elektrophoretische Effekt durch eine örtliches Spannungs-Differential zwischen der Bezugselektrode und der Vorspannung am ersten Ende des erwähnten wenigstens einen ausgewählten Elements bestimmt wird.

17. Verfahren nach Anspruch 16, dadurch gekennzeichnet, daß das erwähnte örtliche Spannungs-Differential die Richtung der Pigmentverschiebung bzw. -bewegung relativ bezüglich der Bezugselektrode bestimmt.

18. Verfahren nach Anspruch 17, umfassend den weiteren Verfahrensschritt der Festhaltung der Pigmentteilchen (36) in einer nach der Induktion des elektrophoretischen Effekts eingenommenen Lage, durch Beseitigen des erwähnten Spannungs-Differentials an den erwähnten ausgewählten Schnittstellen, wodurch das Gas an den erwähnten ausgewählten Schnittstellen entionisiert und eine Kapazität zwischen dem ersten Ende der erwähnten ausgewählten Leiterelemente und der Bezugselektrode gebildet wird.

Revendications

1. Affichage électrophorétique (10) comprenant :

    une paroi barrière diélectrique (14) ayant une première face et une seconde face opposée,
    une plaque avant transparente (12) disposée près de la première face de la paroi barrière, la plaque avant transparente et la première face de la paroi arrière définissant au moins une partie d'un réceptacle imperméable (24) aux fluides ;
    une plaque arrière (16) disposée près de la seconde face de la paroi barrière, la plaque arrière et la seconde face de la paroi barrière définissant au moins une partie d'un réceptacle imperméable aux gaz (26) ;
    une dispersion électrophorétique contenant des particules électrophorétiques (36) suspendues dans un fluide de suspension, ladite dispersion étant contenue dans ledit réceptacle imperméable aux fluides ;
    un gaz ionisable contenu dans le réceptacle imperméable aux gaz ;
    plusieurs éléments conducteurs (30) s'étendant à travers la paroi barrière de la première face à la seconde face, chacun des éléments conducteurs étant isolé des autres et chacun des éléments conducteurs communiquant avec la dispersion électrophorétique et le gaz ionisable ;
    une première pluralité de chemins conducteurs (32) disposés sur la seconde surface de la paroi barrière ;
    une seconde pluralité de chemins conducteurs (28) disposés sur la plaque arrière ; et
    des moyens pour produire un arc (34) à travers le gaz ionisable entre l'un de la première pluralité de trajets conducteurs et l'un de la seconde pluralité de trajets conducteurs, ledit arc appliquant une polarisation électrique à au moins

l'un des éléments conducteurs qui traversent la paroi barrière et créant un effet électrophorétique dans la dispersion électrophorétique.

2. Dispositif selon la revendication 1, dans lequel la première pluralité de chemins conducteurs comprend une pluralité de lignes conductrices de colonnes sensiblement parallèles disposés sur une seconde face de la paroi barrière, et la seconde pluralité de chemins conducteurs comprend une pluralité de lignes conductrices de rangées disposées sur la plaque arrière selon une orientation qui est sensiblement perpendiculaire aux lignes conductrices de colonnes, formant ainsi une matrice X-Y adressable.

3. Dispositif selon la revendication 2, comprenant en outre une électrode de référence (20) disposée sur la plaque avant, l'électrode de référence étant en contact avec la dispersion électrophorétique et faisant de façon générale face à la première face de la paroi barrière.

4. Dispositif selon la revendication 3, comprenant en outre des moyens pour appliquer une polarisation électrique prédéterminée à l'électrode de référence.

5. Dispositif selon la revendication 1, comprenant en outre une pluralité de pixels conducteurs discrets (22) disposés sur la première face de la paroi barrière, dans lequel chacun de la pluralité de pixels est couplé en association électriquement conductrice avec l'un correspondant de la pluralité d'éléments conducteurs.

6. Dispositif selon la revendication 2, dans lequel chacun de la pluralité d'éléments conducteurs est disposé sur la seconde face de la paroi barrière à une position proche d'une intersection correspondante de la matrice X-Y.

7. Dispositif selon la revendication 1, dans lequel la plaque avant est liée à la paroi barrière par un premier espaceur isolant (18) qui sépare la plaque avant de la paroi barrière et définit le réceptacle imperméable aux fluides.

8. Dispositif selon la revendication 7, dans lequel la plaque arrière est liée à la paroi barrière par un second espaceur (18) qui sépare la plaque arrière de la paroi et définit le réceptacle imperméable aux gaz.

9. Dispositif selon la revendication 8, dans lequel l'électrode de référence est disposée sur la plaque avant, une pluralité de lignes de colonnes sont disposées sur la plaque arrière et une pluralité de lignes de rangées sont disposées sur la paroi barrière.

10. Dispositif selon la revendication 1, dans lequel la plaque avant, la plaque arrière et la paroi barrière sont des éléments en forme de plaques sensiblement parallèles et de même dimension.

11. Dispositif selon la revendication 1, dans lequel la plaque arrière et la paroi barrière sont chacune sensiblement transparente.

12. Dispositif selon la revendication 2, dans lequel les lignes conductrices de rangées sont groupées par paires maintenues à des potentiels électriques équivalents les uns aux autres et les éléments conducteurs disposés selon une pluralité de rangées, chacun entre une paire correspondante de lignes conductrices de rangées.

13. Dispositif selon la revendication 5, dans lequel les pixels, la première pluralité de chemins conducteurs et la seconde pluralité de chemins conducteurs sont formés à partir d'oxyde d'indium et d'étain et sont sensiblement transparents.

14. Procédé pour faire fonctionner un affichage électrophorétique ayant un premier réceptacle (24) contenant une dispersion électrophorétique, un second réceptacle (26) contenant un gaz ionisable, les premier et second réceptacles partageant une paroi barrière commune (14), une pluralité d'éléments conducteurs (30) s'étendant à travers la paroi barrière, une première de leurs extrémités étant en contact avec le fluide et une seconde extrémité étant en contact avec le gaz, comprenant les étapes consistant à produire sélectivement un arc (34) dans le second réceptacle proche de la seconde extrémité d'au moins un élément choisi parmi la pluralité d'éléments conducteurs, l'arc ionisant le gaz à proximité de la seconde extrémité produisant une polarisation électrique dans au moins un élément sélectionné, dans lequel la polarisation électrique est subie par la première extrémité d'au moins un élément choisi et induit un effet électrophorétique dans le fluide près de la première extrémité dudit au moins un élément choisi.

15. Procédé selon la revendication 14, dans lequel l'affichage comprend une pluralité de lignes conductrices de colonnes parallèles (32) disposées sur une première face de l'affichage dans le second réceptacle et une pluralité de lignes de conducteurs de rangées (28) isolées entre elles et disposées sur une seconde face de l'affichage dans le second réceptacle pour former une matrice adressable X-Y, l'étape de production sélective d'un arc comprenant l'étape à établir une différence de potentiel aux

intersections choisies de la matrice près de la seconde extrémité d'au moins un élément choisi.

16. Procédé selon la revendication 15, dans lequel l'affichage comprend une électrode de référence (20) contenue dans le premier réceptacle isolé de la première extrémité de la pluralité d'éléments conducteurs et dans lequel l'effet électrophorétique est déterminé par une différence de tension locale entre les électrodes de référence et la polarisation de la première extrémité d'au moins un élément choisi.

17. Procédé selon la revendication 16, dans lequel la polarité de la différence de tension locale détermine la direction de déplacement des pigments par rapport à l'électrode de référence.

18. Procédé selon la revendication 17, comprenant en outre l'étape consistant à maintenir des particules de pigments (36) dans une position occupée ensuite pour induire l'effet pour électrophorétique en enlevant la différence de tension aux intersections choisies pour désioniser ainsi le gaz aux intersections choisies et établir une capacité entre la première extrémité des éléments conducteurs choisis et l'électrode de référence.

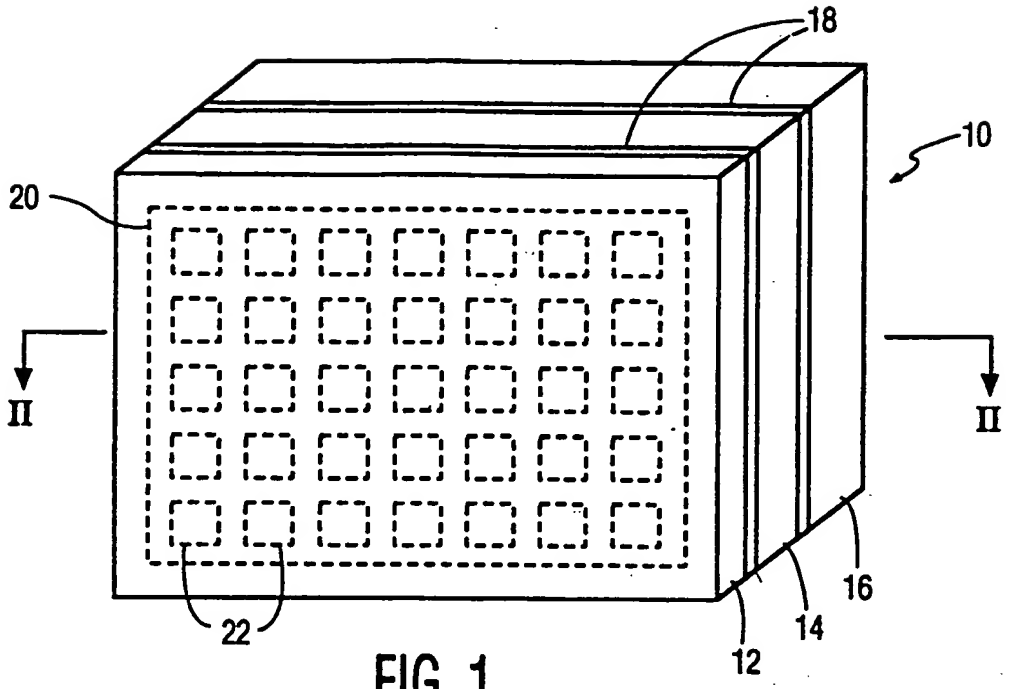
18
10
20
II
II
22
16
14
12

FIG. 1

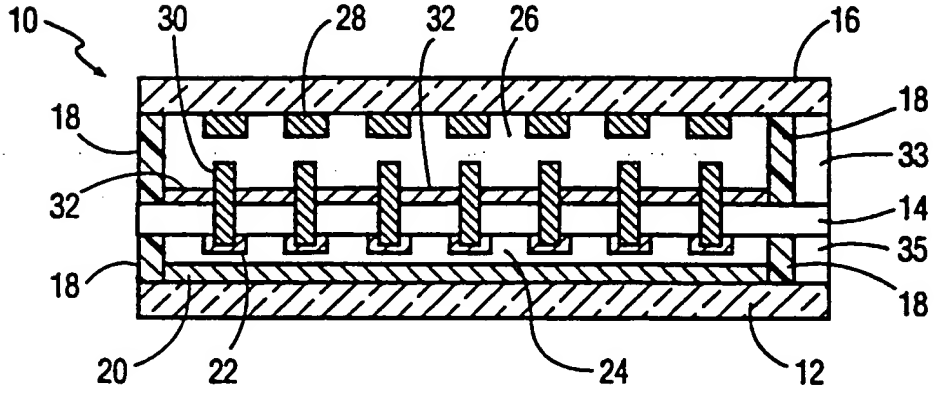
10
30
28
32
26
16
18
18
33
32
14
35
18
18
20
22
24
12

FIG. 2

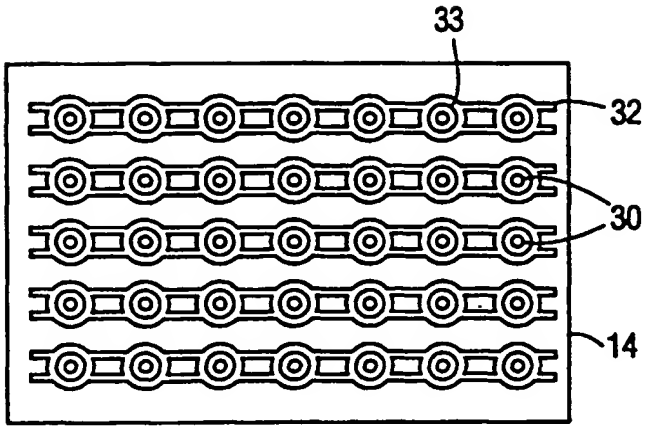

FIG. 3

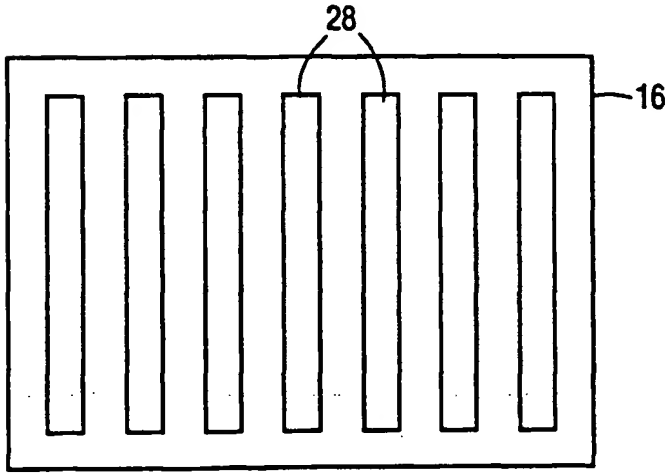

FIG. 4

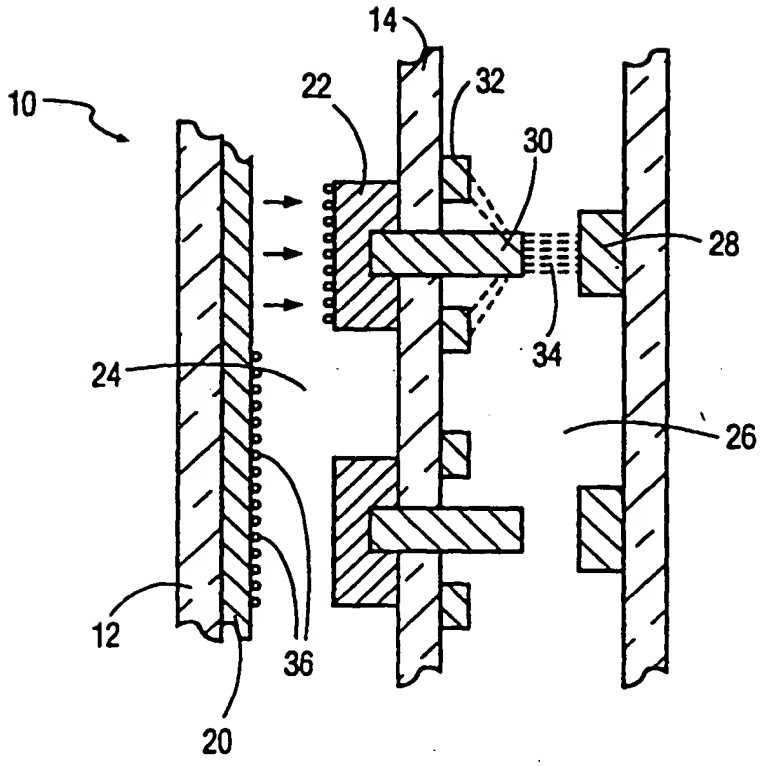

FIG. 5